# Measuring Social Jetlag in Twitter Data

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## Background

**circadian rhythm in humans**

- human schedules are determined by biological and social constraints
- Kantermann et al. (2007) showed that wake timing on free days tracks sunrise during standard time, but not during daylight savings time (DST)
- Roenneberg (2013) argues for much larger sample sizes of real-world data to improve our understanding of human sleep-wake patterns

**Twitter as a social sensor**

- social media use as a proxy for wake/activity times
- environmental effects can be observed in aggregated Twitter data: e.g., number of tweets from NYC peaks later in the day on weekends and during summer (Rios and Lin, 2013)

**A Twitter time series can be used to observe the sleep-wake rhythm in humans and its interaction with DST.**

## Methods

**data**

- used the method of Scheffler (2014) to record German tweets including the phrase *guten morgen* ('good morning') from the streaming API during the period of August 15, 2014 to August 14, 2015
- dataset: 1,443,004 unique tweets from 206,633 individual users (retweets exluded)
- Tweets were binned by 15-minute windows (Fig. 1).

**analysis**

- The time at which the rate of good morning tweets reached half of the maximum (= "onset of Twitter activity") was found by interpolation.
- The relation of this time to the sunrise time and social time was studied.

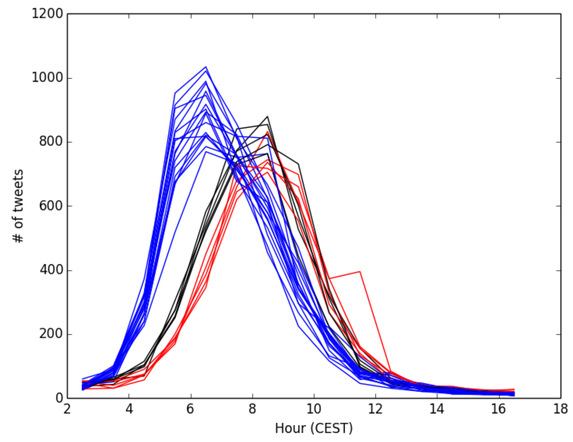


Fig. 1: Hourly tweets containing 'good morning' for each day in the first month of study (2014/8/15 – 2014/9/14).

## Daily Onset of Twitter Activity

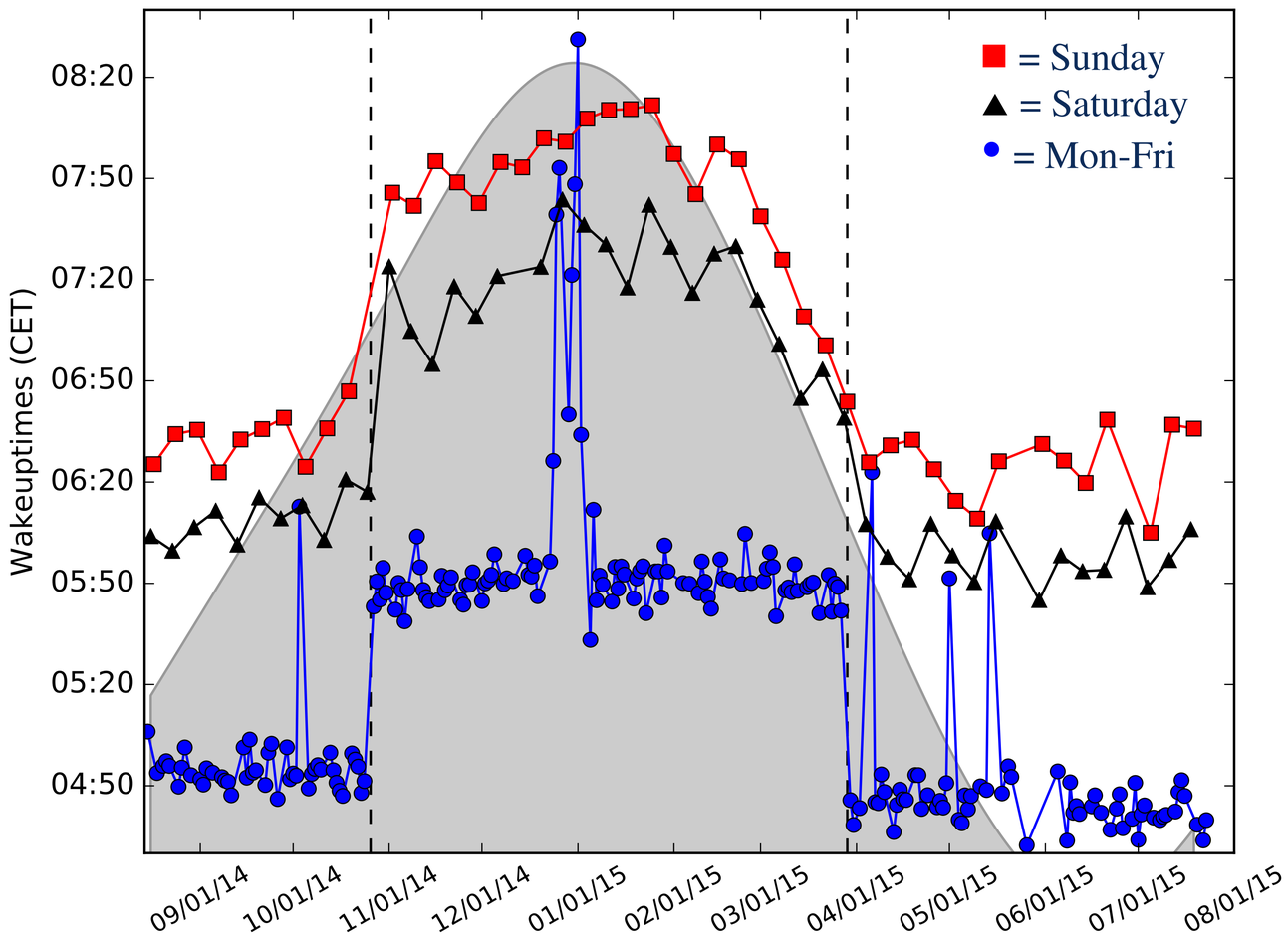


Fig. 2: Daily onset of Twitter activity times (CET) over the study period, August 2014-August 2015. Vertical dashed lines = transition from/to DST. Dawn (in Frankfurt) is shown in the boundary between the white and gray regions.

## Results

**general patterns, DST interactions**

- morning greetings realistically reflect the onset of activity times, between 4:30 and 8:30 local time on weekdays (Fig. 1)
- onset of Twitter activity time (determined geometrically) is related to the local sunrise and social time (week vs. free days and standard vs. daylight savings time)
- onset of Twitter activity is much earlier on week days than on free days (public holidays resemble Saturdays: Oct 3, Apr 6, May 1, May 14)
- during the winter and standard time, the onset of Twitter activity on free days tracks dawn (Fig. 2)
- This relationship ends with the start of DST, and as a result the difference between wake times on free and work days grows considerably.

**interaction with social norms**

We computed the difference in wake time between work and free days for 42 weeks during the study period:

- Saturday: 79±14min
- Sunday: 103±25min
- weekday/weekend difference is largest in January (Saturday: ~99mins, Sunday: ~140mins)
- is smallest in Spring just up to the introduction of DST

## Discussion

- The data shows that onset of activity tracks dawn in the Winter months, but this close tracking is disrupted by the introduction of DST in the Spring, increasing the gap in wake time between work and free days.
- It is not yet known whether the difference between Saturdays and Sundays is related to time of wake up or is specific to onset of Twitter activity.
- These results are consistent with the observations of Kantermann et al. (2007) based on sleep survey data, indicating that social media activity can complement traditional and expanded study of wake timing in an extremely large population.
- This suggests that social media data could be used to evaluate the impact a future policy change in the onset of daylight saving time has on sleep at a population level. The data suggest that reducing the duration of daylight savings time would allow many more people to wake up on work days without the need for an alarm clock.

## Selected References

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**This study:**

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